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A NOVEL DESIGN AND ANALYSIS OF CIRCULARLY ETCHED UWB ANTENNA FOR L, C AND X-BAND APPLICATIONS

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Abstract - *In this paper, a circularly etched patch scheme is described to increase the operation bandwidth of antenna for wideband applications. The proposed antenna has compact dimension of 29 mm ×26 mm with a height of 1 mm and implemented on F4 Epoxy substrate with dielectric permittivity of 4.4. The proposed antenna was simulated using Ansoft High frequency structure simulator (HFSS) electromagnetic simulator. The return losses of designed UWB antenna are good at 1.6 GHz, 4.1 GHz and 8.4 GHz which are < -10 dB and the antenna is useful for L, C and X bands applications respectively.*

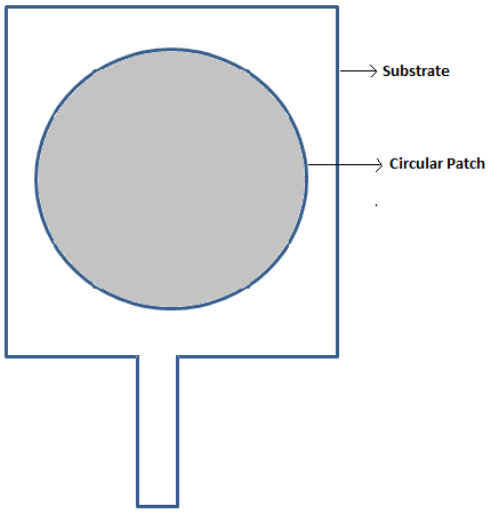
Keywords- Circularly etched, Substrate, bandwidth, HFSS, Return loss, UWB

I. INTRODUCTION

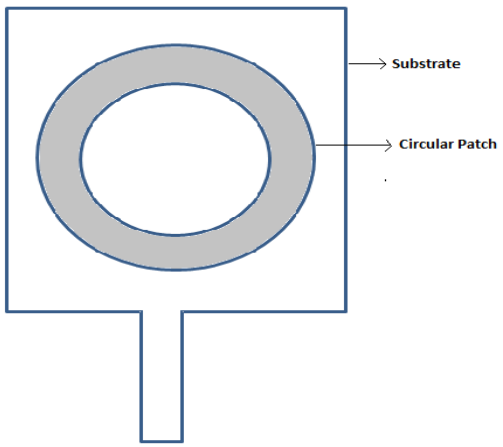
The bandwidth of an antenna is mandatory parameter because it is directly related to the data rate that can be transmitted or received. Moreover, in order to design an antenna into a low volume, high-permittivity substrate materials can be used to shrink the antenna size [1]. Antenna designs for UWB applications are facing many challenges including their impedance matching, radiation stability, and electromagnetic interference (EMI) problems, especially the compact size design [2].

Ultra wideband (UWB) system has been considered and almost recommended for applications in wireless communication due to its capability to provide high speed. A microstrip patch antenna consist of a radiating patch which is placed above the dielectric substrate and a ground plane is placed on the other side of dielectric substrate Microstrip antennas having several advantages such as light weight, low cost, thin profile, conformal to a shaped surface so it can be used in several applications As in aircraft, satellite and wireless communication.

A simple circular shape microstrip patch antenna in its simplest form is shown in Figure 1. Antenna having low profile, wide bandwidth, compact size, low cost, and ease of fabrication slot antennas are attractive candidates for broadband and ultra wideband (UWB) applications.



(a)



(b)

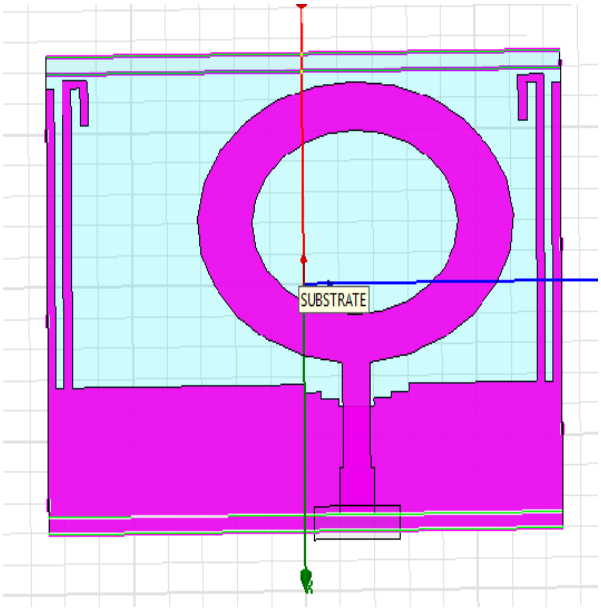
Figure 1: Structure of circular patch antenna (a) Simple circular patch antenna (b) circularly etched patch antenna

The UWB system has frequency range between 3.1-10.6 GHz. The main disadvantage of UWB antenna is having multiple co-existing bands interference and it can be minimized with notched characteristics [3-4]. In recent years, compact antenna with multiband characteristics is topic of interest for research work for application in wireless Communication system [5]. One of the techniques to design a compact microstrip antenna is cutting slots or slits on the radiating patch to increase the length of the patch of the surface current [6-7].

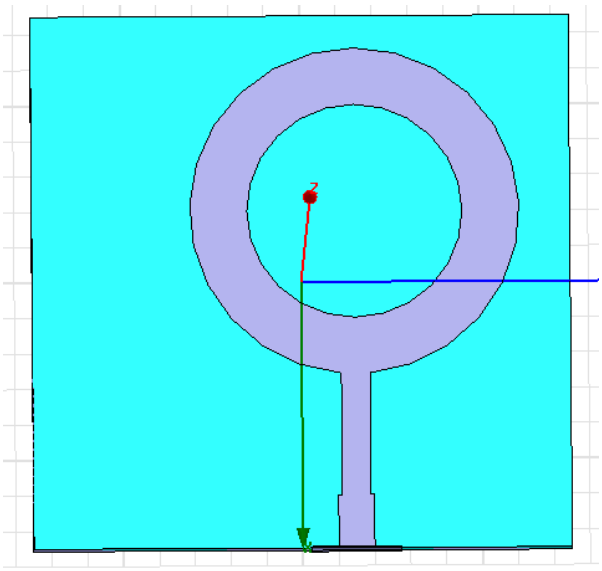
In this paper, a circularly etched patched antenna is designed with four rectangular strips to get multiple resonance frequencies along with UWB property.

II. ANTENNA GEOMETRY

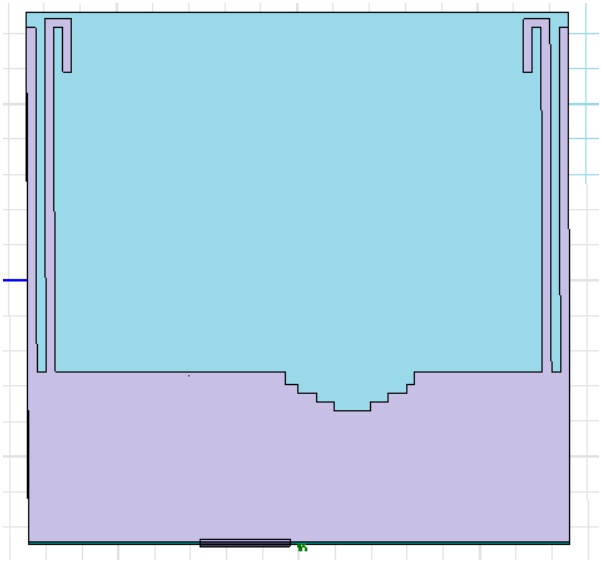
The antenna structures consist of two circles with one rectangular feed structure on the top side of antenna whereas a rectangular with four strips are connected on the back side of antenna as a ground surface. The proposed antenna is designed on FR4 Epoxy substrate with dimension 30 mm × 30 mm with thickness h = 1 mm. The radius of large circle is 9.1 mm and inner circle is 6 mm. This proposed design is feed by a rectangular structure of approximately 10 mm × 2 mm. On the other hand, a simple technique is used in order to obtain the multiple three band resonant frequencies, a rectangular ground with four different strips are used, in which two are at left side and remaining two are at right side. The dimension of first and second strips are 19.5 mm × 0.5 mm and (20 mm × 0.5 + 0.5 mm × 1.5 mm + 3 mm × 0.5 mm) and the other two strips have same dimension with different position.



(a) General View



(b) Top view



(c) Bottom view

Figure 2: HFSS Design of proposed Antenna views (a) General view (b) Top view (c) Bottom view

The strips have the width and gaps of 0.5 mm and the stair design has also the dimension of 0.5 mm × 0.5 mm as length and breadth for every single unit. All numerical simulations are performed with HFSS [8], based on the finite element method.

III. RESULTS AND ANALYSIS

The return loss of circularly etched antenna are found as -15.36 dB, -15.46 dB and -34.17 dB at 1.6 GHz, 4.1 GHz and 8.4 GHz frequencies respectively (< -10 dB).

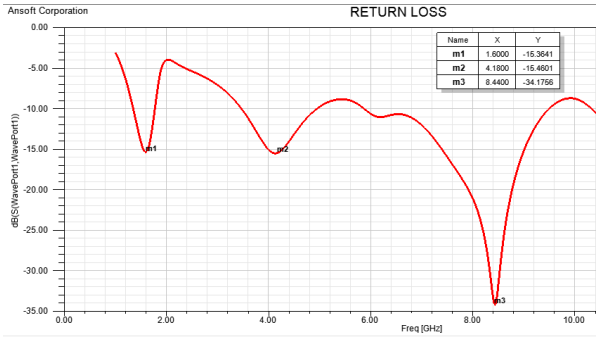


Figure 3: Return Loss of proposed antenna

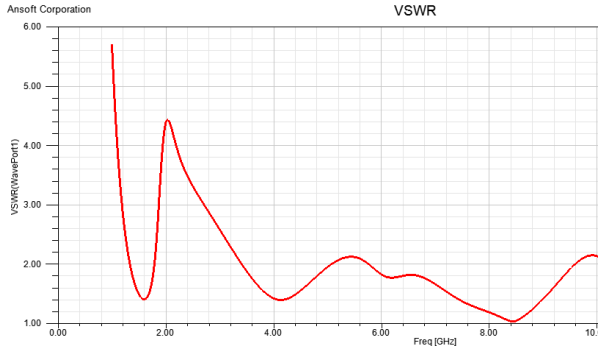
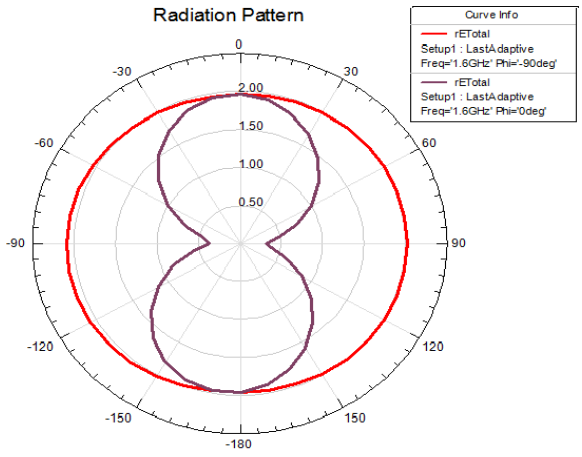
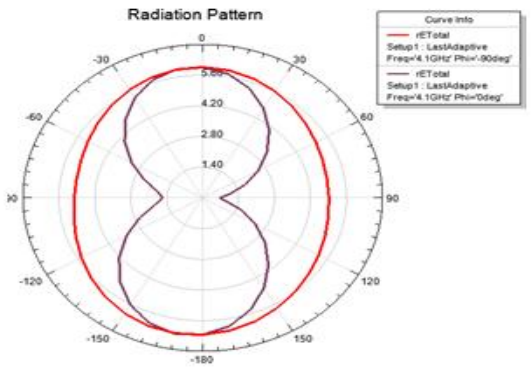


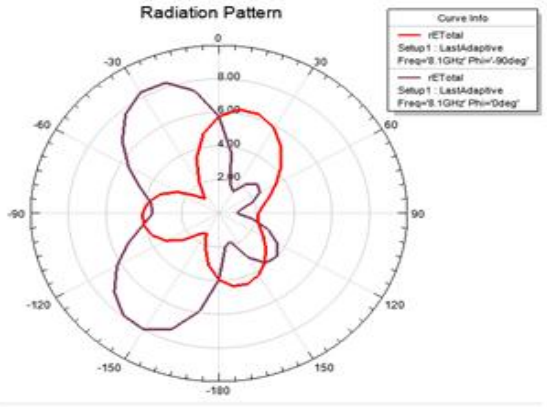
Figure 4: VSWR of proposed antenna



(a)

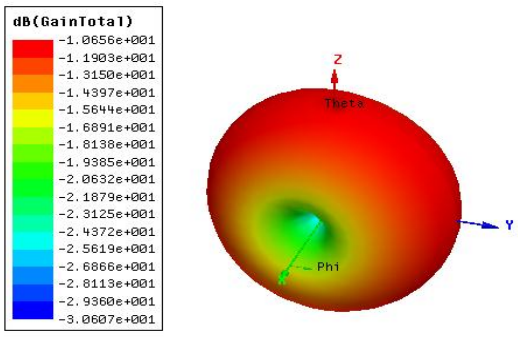


(b)

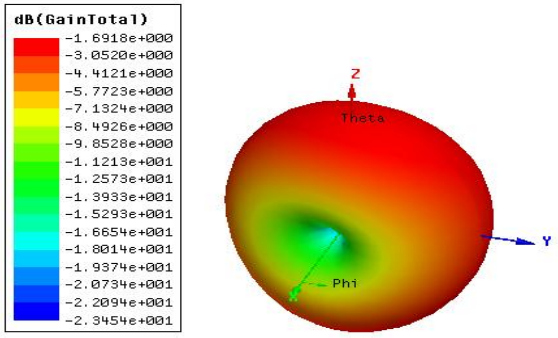


(c)

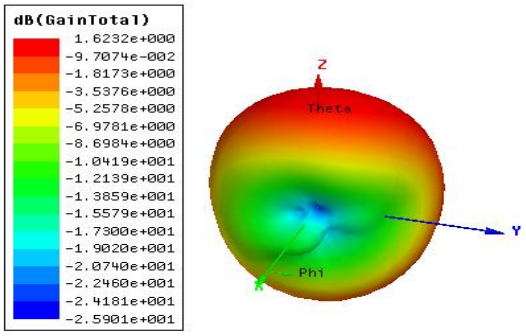
Figure 5: Radiation patterns of proposed antenna (a) at 1.6 GHz (b) at 4.1 GHz and (c) at 8.4 GHz



(a) 3-D Polar Far Field pattern at 1.6 GHz

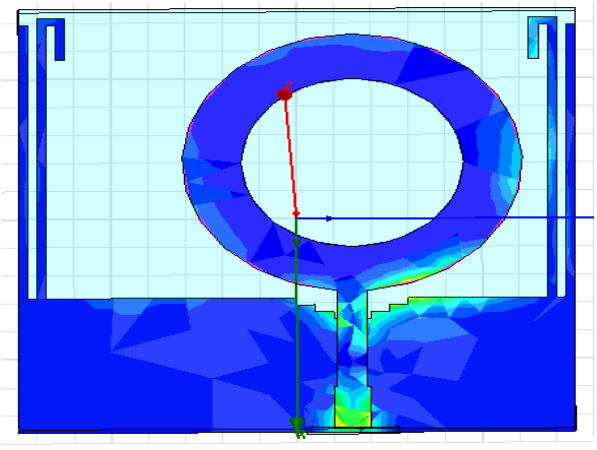


(b) 3-D Polar Far Field pattern at 4.1 GHz

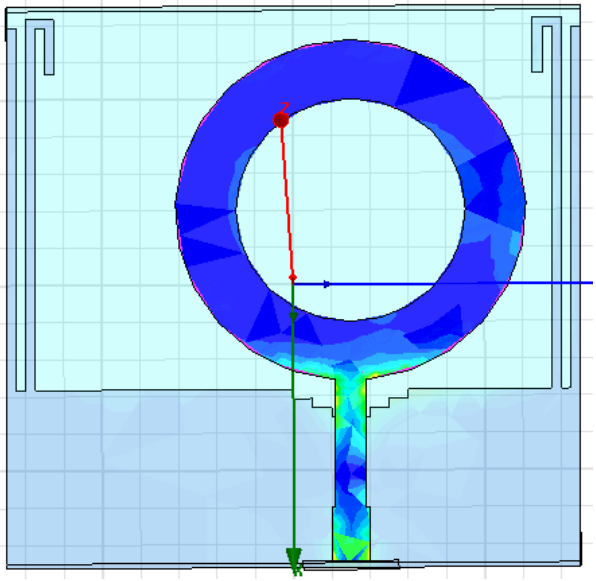


(c) 3-D Polar Far Field pattern at 8.4 GHz

Figure 6: 3-D Far-field radiation pattern of the proposed antenna (a) at 1.6 GHz (b) at 4.1 GHz and (c) at 8.4 GHz



(a) E –field



(b) H –field

Figure.7. Field plot of the proposed antenna (a) E- field and (b) H-field

IV. CONCLUSION

The performance characteristic of circularly etched UWB patch antenna has been presented. From the above various results such as return loss, VSWR and radiation pattern, the designed antenna satisfy all the design conditions at the 1.6 GHz, 4.1 GHz and 8.4 GHz. This antenna can be used as UWB as well as triple wide band applications.

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BIOGRAPHIES

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